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ORIGINAL ARTICLE

Resource allocation criteria in a hospital

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Keywords

Resources • Allocation • Hospital

Summary

Introduction. *Allocate fixed resources among competing users is a challenge in terms of hospital management in order to obtain the best performance considering strategic objectives. In order to address this need, a system of evaluation in an important research and teaching hospital was designed. This study describes resource allocation criteria in a hospital focusing on the evaluation system and its developed application methodology.*
Methods. *The indicator system allows the strategic management to rapidly detect the priorities in the evaluations of the Strategic, Organizational, Managerial, Economic, Research and Qualitative conditions of each unit. The chosen indicators are expressed with three numerical values, (1 indicating critical status, 2 acceptable conditions and 3 a good operational situation).*
Results and discussion. *The adopted evaluation system considered different thematic areas: Strategic, Organizational, Managerial, Economic, Research and Qualitative. In order to define each area, 3 fields of evaluation have been chosen. The indicators have been structured according to a pyramid system allowing creating a single indicator for each area for each unit. Furthermore, a single indicator has been fixed in order to facilitate a first consideration on whether to carry out or not closer examinations of the most critical units. This manuscript describes an attempt to define objective criteria for the allocation of scarce resources in order to achieve the hospital's strategic objectives. The indicators identified allow to obtain an overall score for each unit, which allows the management to prioritize the needs.*

Introduction

The allocation process concerning the more and more limited health resources presents several criticisms at different levels: macro (national/regional), meso (institutional/territory-hospital) and micro (at patient bedside). In particular the meso level plays a fundamental role in the resources management by representing the point of reference in the health services supply [1].
The health sector and, more specifically, the hospitals have been asked, over the last years, to manage fixed resources with respect to the increasing activity levels [2], due to the ever-increasing number of needs from a population which is older and older and who bears many co-pathologies that have to be treated with territorial out-of-hospital care services which are not always effective. Therefore, it is necessary defining the hospital priorities and criteria of resources allocation.
The different models, that have been studied for the strategic planning of healthcare [1, 3, 4] and, in particular of hospitals, take into account different aspects: the context in which the organization operates, the involvement of stakeholders, the definition of those processes that shall be managed and of those criteria for the resources allocation testifying the work done and certifying its validity [1]. The resources allocation models also in the healthcare sector, are based on economic efficiency, justice, equity, sharing and optimization of the resources themselves [4].
This manuscript describes the evaluation system through indicators both from a conceptual and illustrative point of view explaining the principles of the system and the developed application methodology. The objective is evaluating the strategic positioning, the operating activities, the economic results, the research, organization and the qualities of all the hospital unit. The model was built for an hospital offering third level activities, first level post-university centre, a research centre benefiting from both national and international funding, a place of reference for over 250 rare diseases, three emergency departments and more than ten block.

Methods

The developed model identified 6 thematic areas that can represent the managerial condition of a complex hospital. They can be named as follows: Strategic, Operating, Research, Economic, Organizational, Quality. Within these areas, some qualitative and quantitative evaluation elements have been chosen; they are considered as most significant.
Each thematic area has been given three indicators that were considered as adequately representative to evaluate the position of a specific unit in that area. The indicators

selected to evaluated each area were chosen for some reasons:

- they were the same identified in other similar evaluations;
- the hospital has data to calculate them;
- the hospital management board wants comparing units in order to develop strategic activities devoted to research and teaching, but according to the medical and surgical activities that the hospital has to perform.

Some indicators are referred to the activity of doctors operating in the different units. In order to obtain a datum that reflects as much as possible their actual commitment. The concept of "Equivalent Doctor" (d_e), was adopted with the aims at reporting the real time that the physician dedicates to the clinical activity. Conventionally, as time of the d_e it is possible to use 1500 h/year. The indicators have been structured according to a pyramid system allowing to create a single indicator for each unit.

The purpose of the single indicator is to immediately highlight, within the same area, what is the positioning of the unit under consideration.

The indicator system allows the strategic management to rapidly detect the priorities in the evaluations of the Strategic, Organizational, Managerial, Economic, Research and Qualitative conditions of each unit, within the ambit of its own relevant area.

For each thematic area, the chosen indicators are expressed with three numerical values, attributing:

- value 1 to the values belonging to the segment lower than the average value, indicating the appropriateness of checking the insufficiency status of the unit taken into consideration (critical status);
- value 2 to the segment of approximately +/- 20% near the average value, indicating that the unit taken into consideration is among those to be considered in acceptable conditions;
- value 3 to those located in the segment higher than the average value, indicating, in this case, a good or satisfactory operational situation.

No ethical approval was requested to carry out this study.

Results

The model with its six areas and for each area the three fields of evaluation was presented.

A - Strategic Area

A1 - The Importance of the Hospital: at local, regional and national level

This evaluation takes into consideration the level of importance attributed to the activity carried out.

A2 - The Importance of the potential for development: at local, regional and national level

This evaluation plays a fundamental role in the decision-making process to accept or reject the request for new resources with regard to the hospital development programmes.

The top management on the strength of the objectives that it wants to achieve will therefore decide whether to encourage the development and the professional growth of a specific unit or not.

A3 - Necessary professional specificities even in the presence of enough personnel

This evaluation takes into consideration the professional level that in a specific unit has to be maintained or increased.

It is obvious that, unlike the indicators of the other areas, these evaluations are made on a qualitative basis.

The evaluations of this thematic area are also assigned a three-level score (1, 2, 3) in order to participate in the creation of the single indicator.

B - Operating Area

This area takes into account the medical staff, and it is useful to assess whether their number is adequate to the activity performed in a specific unit or not. The number of doctors can meet the accreditation requirements but it has to be considered the fact that these are minimum requirements therefore they can be insufficient for the type of work carried out in the individual unit.

B1 - Institutional clinical activity

For all the units it has been taken into consideration: the number of equivalent doctors and the number of yearly clinical performance for ordinary admissions to hospital (OA), for day hospital admissions (DH) and for the outpatient examinations (OE).

In the case of OA the number of performance has been adjusted multiplying it by the rate of case mix, in order to take into consideration the objective difference of clinical complexity, and by the number of the average days of hospitalization in order to consider the more time that the doctor has to spend performing this kind of clinical performance.

For each of these clinical activities the number of individual performance has then been compared with the average value of all the analogous performance carried out by the units belonging to the same area, assigning this way the three sub-indicators characterizing the degree of efficiency of the single clinical activities (OA-DH-OE) performed by every single unit. This assessment was performed as follows.

Having taken the average value as reference, a segment equal to +/- 20% was set, the coefficient 2 was included among its values. This number indicates that the activity referred to in the assessment can be considered as sufficiently in conformity with the value expected in a correct management, and therefore not in need of human resources allocation since it is balanced with the resources at disposal.

If there is no clinical activity it is given the 0 value; if it is lower than the average segment the value is 1 and if it is higher than the average segment the value is 3.

Then a single indicator of the institutional clinical activity has been established by transforming these three indicators into a single index named "clinical efficiency index", that in line with what has been previously stated,

allows to be transformed into the "institutional clinical activity" indicator.

B2 - Clinical activity performed for other units- Emergency medical service shifts

This evaluation element indicates the importance of the treatment activity that the examined unit carries out on behalf of the other units of the hospital that is to say that some working days have been subtracted to the clinical activity in the unit of belonging.

Since this service falls within the type of organization that the hospital decided to follow, it represents a commitment that all the units have to fulfil, we thought to compare the number of emergency medical service shifts performed by each unit divided by the number of doctors on the roll, with the average obtained by all the equivalent doctors of the other units belonging to the same area, to assess its position compared to the one that can be considered as an average obligation, and therefore in line with the standard procedures.

Also in this case the so obtained values coming within the +/- 20% segment have been given number 2, to indicate that the commitment to the service of the other units is in line with the standards and, therefore, this is not a critical situation. The values below this segment have been given number 1, to indicate that the commitment of the emergency medical services does not significantly vary the work performed in that unit being below the average, that is to say below the standard procedures.

In the opposite case, the values above the average segment, have been given number 3, which means a load of emergency medical services more demanding than what is usually expected.

Finally when the emergency medical service is not performed we give 0.

B3 - Doctors of an unit/total employed staff ratio

It represents the percentage of doctors in the total employed staff. If the indicator is below the average or percentages of the operating units belonging to the same area, the indicator is given number 1, which means a possible lack of doctors; if it is above the average it is given number 3 to indicate that the percentage of doctors is above the average and, therefore it points out a possible superabundance of doctors. Number 2 indicates that the unit comes within the +/- 20% segment near the average value and also that the unit is in a state of balance.

C - Research Area

Considering that the research is an integral part of the clinical activity of every doctor who works in a research hospital, with this thematic area we wanted to highlight the commitment of every doctor for research.

C1 - Impact Factor

As known, the impact factor (IF) gives an official representation of the research activity carried out by the researchers of an unit.

It is the significant official recognition of the research carried out, but it is not exhaustive since a part of the research performed is not mentioned in the official publications and, therefore, the IF cannot be considered as a recognition of the whole research carried out by an unit.

Considering that the research volume is presumably higher where the number of doctors is higher, we thought it proper to compare the IF to the number of equivalent doctors existing in the different units.

This benchmark is given a score from 0 to 3. 0 when there is no research activity, 1 when the activity is located below the average value decreased by 20%, 2 when the activity is placed in the segment defined by +/- 20% of the average value, 3 for the activity placed above the average value increased by 20%.

The benchmark reading therefore points out if the doctors' productivity is satisfactory, on average adequate or even critical, requesting close substantive analyses.

C2 - Extra financing for current research

This index aims at highlighting the production capacity that a specific unit has in obtaining financing not coming from the ministerial source.

This depends not only on the promotional ability that the chief doctor can exercise c/o the non-governmental and private bodies in order to obtain financing for the research, but also on the reputation that the unit has in the scientific world, and on its knowledge and experiences in specific areas.

The indicator was created starting from the financing given to each unit divided by the corresponding number of equivalent doctors considered as devoted to research, and comparing the result with the average value obtained by the same reports of the other units belonging to the same area.

As in the above indicators, its value is assessed according to its positioning whether inside or outside a segment of values included between +/- 20% of the average value.

Number 0 indicates that the unit does not raise funds besides the ones for the current research. Number 1, given to those values included below the average value decreased by 20%, indicates an unsatisfactory financing attracting capacity compared to the average of the other units. On the contrary, number 3 indicates a satisfactory situation.

C3 - Temporary staff devoted to research

This index represents the significance of the staff hired temporarily, such as for example the holders of a scholarship and contract researchers, employed in the research, compared to the number of doctors who devote to research and when such significance is relatively high it means that the research activity is substantial.

The ability to attract this kind of staff is connected to the ability to attract non-ministerial funds and it indicates a good functioning of the unit, which does not need any corrective action to be performed toward the employees, unless in case of specific strategic reasons such as to ensure the preservation of the know-how acquired through the research.

In order to assess the indicator, the number of this temporary staff shall be expressed as a percentage compared to the number of equivalent doctors. The average value of all percentages of the units belonging to the same area has to be considered as a reference to define the indicator, obtained with the same criteria repeatedly explained

in the other indicators, in the scale of reference, from 0 to 3. That is to say 0 when there are no holders of a scholarship and contract researchers, 1 when the percentage of this type of temporary employees together with the permanent employees is below the value reported by the average segment, 3 when it is above it.

D - Economic Area

D1 - Total revenues from clinical activity

The revenues from OA, DH and OE have been taken into account, obtaining this way the annual revenue of each unit.

The total revenues have been attributed to the number of doctors belonging to the considered unit, in order to quantify the production efficiency of each doctor. The deriving indicator has a value equal to 1 or 2 or 3 depending on the fact that such efficiency is lower than the average, on average or higher than the average respectively.

D2 - Operating margins

From the total annual revenue indicated above variable costs and the cost of personnel have been deducted obtaining, therefore, the Gross Operating Margin of each unit.

Among the variable costs we have taken into consideration the consumption of healthcare material, of office tools and supplies, the laboratory and radiology costs.

The indicator assessment is analogous to the one reported in section D1.

D3 - Other revenues

It mainly refers to grants related to income obtained by the unit thanks to special activities which cannot be identified through the DRGs, the range of fees of outpatient treatments and/or the research activity. The revenues from non-clinical activities, like the sale of plasma bags, also belong to this category.

The calculation methods for this indicator are equal to those indicated in the previous D1 and D2 sections.

E - Organizational Area

In this area the number of doctors are always evaluated taking into account the accreditations rules of the Lombardia Region.

E1 - Logistics: operating divisions

The location in which the activity of a specific unit is carried out is taken into consideration in order to evaluate whether the logistic conditions in which the work has been performed are optimum or not.

Where the arrangement of the working areas is not functional and coherent within the same block shared with the other units of the same Department, or in the presence of a chaotic arrangement or, worst, of a division into more blocks, obviously the work efficiency cannot be satisfactory.

In order to evaluate the effect on the work efficiency of such possible different situations a different importance has been attributed to the type of logistic arrangement in which every single unit operates, that is to say the number of floors or of blocks, and the sum of such values has been divided by the number of employed doctors who, in theory, are spread in them. According to the other scores value 1 means that in that specific unit doctors work in an environment which is more fragmented from a logistic point of view compared to the average, value 2 means that the situation is normal, and value 3 means that the presence of doctors in the departments is above the average.

E2- Event organization

This indicator refers to the organizational skills of the personnel. It examines the number of cultural events: conferences, professional refresher courses, on-the-job training, which have been organized during the examined period. The indicator depending on whether the number of events promoted by the doctors of the examined unit is below or above the average with 3 refers to the superior ability that doctors have shown.

E3- Outpatient clinic Logistics – Laboratories

With reference to every single unit, this index aims at pointing out the managerial complexity connected to the number of outpatient clinics and laboratories. A high number of outpatient clinics compared to the arithmetic mean of those existing in the other units of the same area could indicate a heavy functional organization.

As in E1 the indicator takes into account the number of doctors operating in the outpatient clinics/laboratories and it is expressed by means of number 1-2-3. In this case index 3 means that the number of doctors using the outpatient clinics and/or laboratories is higher than the average, and, therefore, there is an evidence that the use is high, while index 1 means that their number is below the average, and this could indicate that there can be a poorly targeted use of outpatient clinics and/or laboratories. Number 2, as usual, indicates an average use of outpatient clinics and/or laboratories as regards the units of the same area to which they belong.

F - Quality Area

From a strategic point of view, checking this aspect is fundamental, since it gives indications on the market positioning of the unit within the healthcare offer that is to say on the "reputation" (or "success") built through the quality of the service performed.

Quality indications can mix, obviously together with the other managerial and operating evaluations, proper and accurate corrective and/or improvement actions.

F1 - Commendations to personnel

Within the ambit of the Quality Area the indicator "Commendations to personnel" was selected as a proportion between the number of commendations praised on an unit, obtainable from the remarks that reached the offices in charge of the relations with the public, and the number of doctors operating in the unit itself.

If the proportion obtained is above the average of reports examined for all the units belonging to the same area, it can be presumed that, according to the user's opinion, the medical personnel is able to operate satisfactorily.

On the contrary, if the proportion mentioned above is below the average, it can be presumed that the users' satisfaction with the quality of healthcare performance is

not highly satisfied. The value of the indicator therefore allows to report a critical situation or, at least, susceptible of improvement.
Similarly to what is reported above, the indicators are expressed by increasing values 1, 2, 3 from a condition below the average to one above it.
F2 - Claims against clinical activity
It provides indications about the organizational and procedural activities of an unit, through the assessment of claims against it.
The *modus operandi* for the assessment of the indicator is always the same. However in this case index 3 means that in the unit claims against doctors are lower than the average and index 1 that claims against doctors are above the average.
F3 - Litigation
It indicates the actions brought against the hospital by patients or by their families subsequently to derelictions of duty and/or malpractice by the healthcare personnel, to diagnostic and/or therapeutic errors, to negative outcome after health interventions, etc. In general, considering the fact that the litigation is presumably more significant where the concentration of activities is higher, this is another example in which the litigation is referred to the number of doctors of the unit.
Also in this event the values go from 1 to 3, where 1 means a relatively high number of legal actions, 2 an average situation and 3 a low number of legal actions.

G - Single Indicator

After having fixed the indicators concerning the six thematic areas, A B C D E F, in order to facilitate a first consideration on whether to carry out or not closer examinations of the most critical units, a single indicator has been fixed. This is able to provide a macro insight of how the single unit of a same area is placed compared to the others.
This gives an immediate indication on the opportunity to evaluate more deeply and more in detail the most critical units through the analysis of the thematic areas indicators.
The single indicator is obtained through the sum of the indicators assigned to every single unit and through the division of the sum by the number of the units of the same rea, this way the average value of the single indicator can be achieved. The examination of the unit positioning compared to such average will enable a quick assessment of the criticality status, acceptable standard and satisfactory situation.
As for the other indicators, the segment included between +/- 20% of the average value is considered as an average standard working situation.
To each thematic area examined has been given a different importance, variable from 1 to 3, in order to take into account the different importance given to them during the data analysis. In particular, importance 3 has been given to the operating area, 2 to Research and 1 to the remaining areas.

Discussion

The presented method is not limitless. First of all the health outcomes are not examined, but only their proxies [5]. Then the development of the analysis technology concerns only one part of the strategic planning process, which refers to the definition of objectives, their sharing with all the interested parties and their operationalization. This last step consists in transferring the hospital strategy to specific objectives for every single unit [1].
This work illustrates a proposal for a practical method aimed at allowing the strategic management of a complex hospital to have a sort of "Dashboard" able to provide it with an overview on the conditions of the duly aggregated units for the decision making process purpose.
The "Dashboar" takes into consideration the assessment of the activity conditions and of the units positioning, such units are aggregated by "areas", by means of a multidimensional approach fixed on six thematic areas: Strategic, Operating, Research, Economic, Organizational, Quality.
Such thematic areas can be given different scores from 0 to 1 depending on the importance attributed.
Each area is characterized by a set of three quantitative indicators, except the Strategic Area which consists of qualitative indicators, to which are given conventional scores equal to 1, 2, 3 depending on their positioning compared to the average value of the values obtained by the other units belonging to the same area.
On the basis of such data it is possible to obtain a total score for each unit, by means of which significant comparisons can be carried out among the different units.
The comparison makes possible the fast detection of points of strength, criticality or weakness, such information can be followed by possible accurate deep investigations.
The feasibility and completeness of the method are based on the availability and accessibility of data concerning the activities identified by each thematic area. Such data shall be periodically produced and validated in order to gather all information to use for the assessment of indicators. For a good use of this observation and control method employed for the managerial activity of the different units it is necessary that the data collection from the competent sources, and the management of the "Dashboard" are performed in an organized and systematic way.
This method was yet not implemented because the strategic management board of the hospital finished its agency and they were not renewed. The new named strategic management board is evaluating it.
On the other hand it is possible to adopt, where present, an automatic data processing by means of a simple application software able to process the basic data by extrapolating them directly from the software of the hospital information system.
The possibility to make decisions on the basis of the information obtained through the indicators helps to avoid the impulsive decisions which are often objectively unfounded [6].

Conclusions

The developed instrument should allow the Management to have an overall view on the conditions of the clinical units, by means of a group of significant indicators.
The priority principle in the development of this studied model is the one to use a limited number of indicators in order to allow their easy and immediate use, without requiring a high waste of time by the user for their evaluation. Those data which are necessary to constitute the indicator can be easily acquired from the routine data flows of an hospital.
The allocation of fixed resources (i.e. personnel, services, etc.) among the users/suppliers in competition with one another, from a managerial point of view it represents a challenge aimed at obtaining the best hospital performance in full obedience of the shared strategic objectives.

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Authors' contributions

SC conceived, designed and coordinated the research. AB collected data. SC and AB optimized the informatics database. SC, AB and AP evaluated the results. SC and AB wrote the manuscript. All authors read and approved the final manuscript.

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